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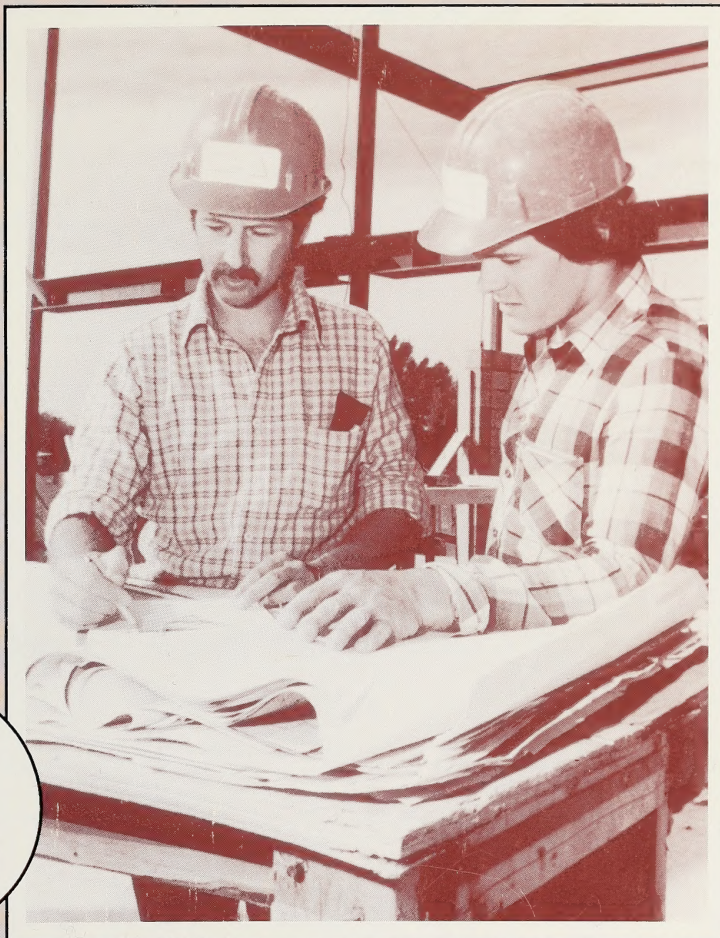
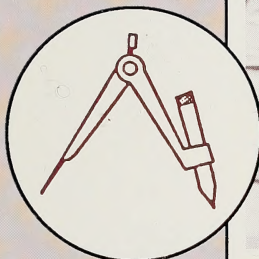
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MODULE 6

LOGO BOOKLET



MATHEMATICS 7



**Distance
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Mathematics 7

Module 6

Measurement and Geometry

LOGO BOOKLET

Mathematics 7
Logo Booklet
Module 6
Measurement and Geometry
Alberta Distance Learning Centre
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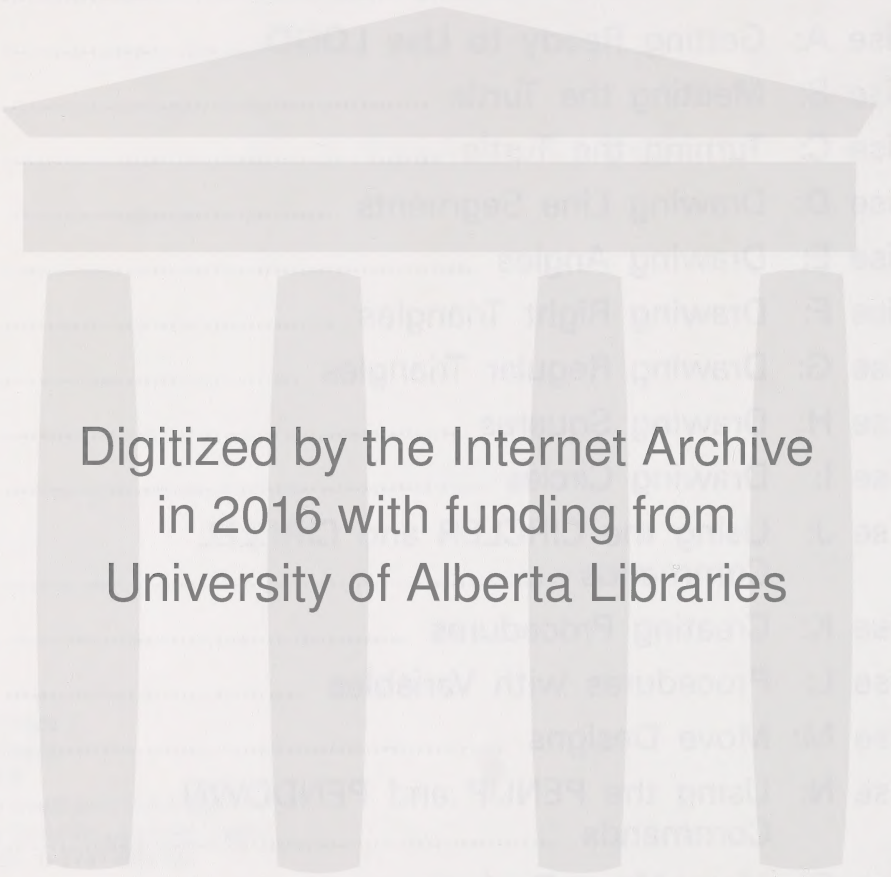
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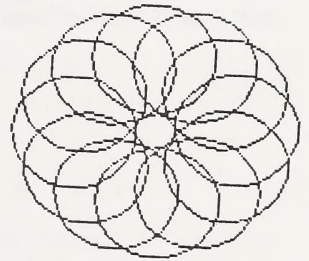
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Overview

Welcome to LOGO! LOGO is a computer programming language. It uses a drawing system referred to as **turtle graphics**.

Dr. Seymour Papert, working with a group of scientists, created LOGO during the late 1960's and early 1970's. Dr. Papert got the idea for this computer programming language after watching a computer direct a pen to draw a picture. The pen was mounted in an apparatus that looked like an upside bowl or a turtle. Dr. Papert realized that this turtle was a unique way to learn problem solving.

LOGO is an easy stepping stone into the world of computer programming. It is also a wonderful tool for learning geometry. For example, this pattern can be created using LOGO and a computer. This booklet will teach you how to draw figures and designs with the computer.



Exercise A: Getting Ready to Use LOGO

To use LOGO you will need the following machines (**hardware**): a computer, a disk drive, and a monitor. You will also need a LOGO language diskette (**software**).

Note: This booklet is written for the Apple computer.

To use LOGO you must first place the LOGO language into the computer's memory. Simply insert the LOGO diskette into the disk drive and turn on the computer.

When the light on the disk drive stops, you will see a message on the screen.

PRESS THE RETURN KEY TO BEGIN
IF YOU HAVE YOUR OWN FILE DISKETTE, INSERT IT NOW, THEN
PRESS RETURN

You do not need a file diskette for this booklet so press

< RETURN >



Any word or letters in angle brackets represents a single key on the keyboard.

You will see this message on the screen.

WELCOME TO LOGO
?■

You can now remove the LOGO diskette. The LOGO language will stay in the computer's memory as long as it is turned on.

Note

If you decide to stop at any point in this booklet and turn off the computer, you will have to load the LOGO program again when you return to this booklet.

Let's look at the screen more carefully.

Notice that below the message is a question mark and a flashing square.

WELCOME TO LOGO
?■

The question mark is called a **prompt**. It is the computer's way of saying "Tell me what to do."

Next to the question mark is a flashing square called the **cursor**. When you type a key on the keyboard, the character (letter, number, or symbol) on the key will take the place of the cursor and the flashing square will move to the right.

LOGO has many built-in commands. When you type a command, and press **<RETURN>**, the computer follows your command. These commands are easy to learn and to use.

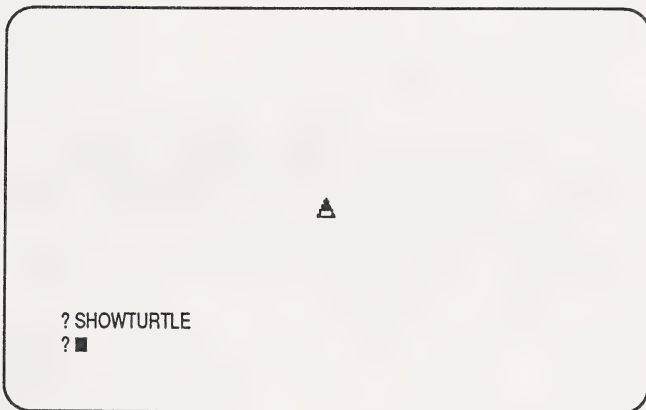
Exercise B: Meeting the Turtle

Let's meet the turtle now. Type

SHOWTURTLE <RETURN>

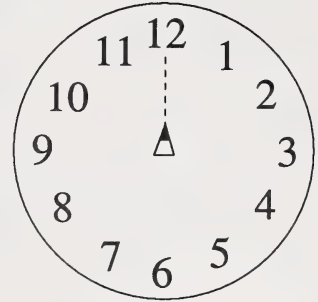
Type the word in bold and then press <RETURN>. Do not include any spaces. Remember the angle brackets simply indicate a single key. If you make a mistake typing before you press <RETURN>, use the backspace to correct your error. If you press <RETURN> before you correct the typing error, simply retype the command.

The screen changes and the turtle appears.



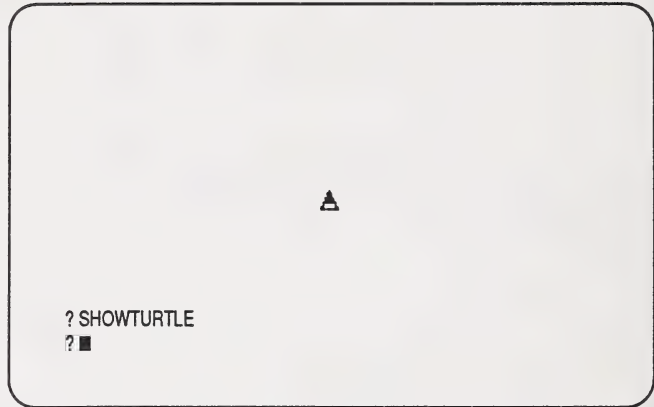
This turtle is the tool with which you will draw figures and designs on the draw screen. By typing LOGO commands you will tell the turtle where to travel on the draw screen. As it moves, the turtle will leave a path. This path becomes your drawing, figure, or design.

When you type: **SHOWTURTLE** the turtle appears in the middle of the screen. The nose of the turtle is pointing in an upwards direction. If you think of a clock, it is pointing to 12 o'clock. This is the turtle's home position.



Now look at the screen more carefully.

The top part of the screen will be used for drawing. The bottom of the screen is used to display text — the commands you've typed and any messages from the turtle.



Because the screen seems to be divided into parts, it is called a **split screen**.

Exercise C: Turning the Turtle

Let's make the turtle turn and learn some more LOGO commands.

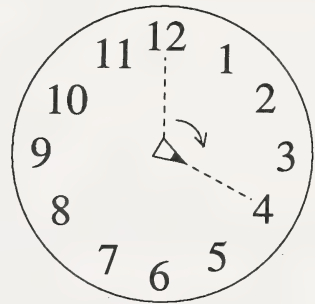
You can make the turtle turn right or left. Let's begin by telling the turtle to turn right 120 degrees. Type

RIGHT 120 <RETURN>

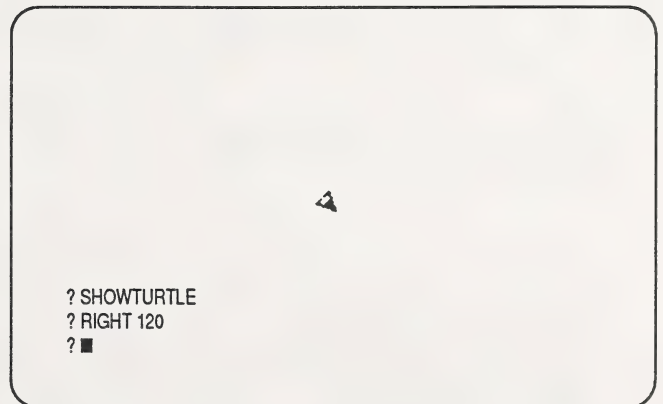


The space between the command and the number is important. Press the space bar to make a space.

The turtle turns right 120 degrees. If you imagine a clock, the turtle moves from pointing to 12 o'clock, to pointing to 4 o'clock.

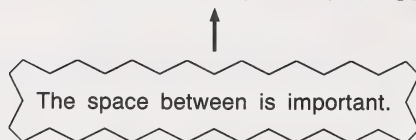


Notice that the command appears in the text part of the split screen beside the question mark. There is another question mark and the cursor on the next line. The computer is waiting for your next command.

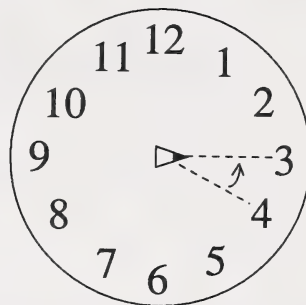


Next let's tell the turtle to turn left 30 degrees. Type

LEFT 30 <RETURN>



The turtle turns left 30 degrees. It moves from pointing to 4 o'clock to pointing to 3 o'clock.



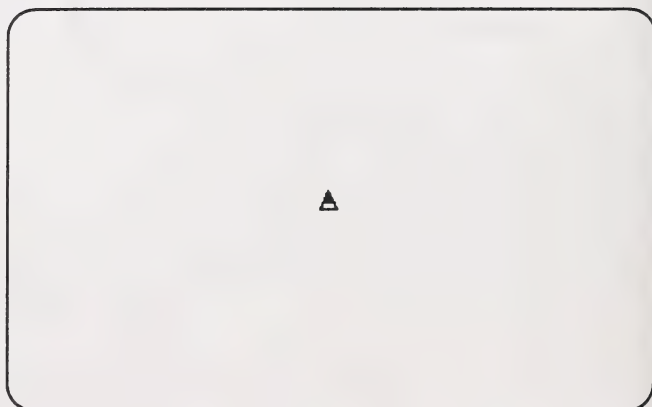
How can you tell the turtle to go to its home position — the centre of the screen pointing towards 12 o'clock?

One way to do this is to use another LOGO command. Type

HOME <RETURN>

The turtle returns to its **HOME** position.

There will be commands written at the bottom of your screen, but from now on the commands won't be shown in the illustrations in this booklet.

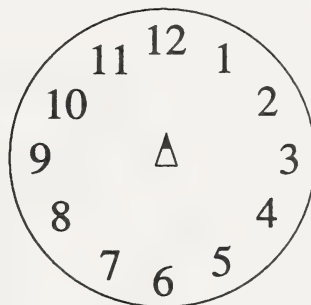


So far you have learned these LOGO commands: **SHOWTURTLE**
RIGHT
LEFT
HOME

Notice that the **RIGHT** and **LEFT** commands require numerical inputs after them. A space is left between the command and the number.

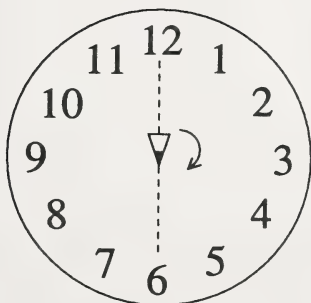
1. Experiment making turns.

2. Tell what right and left commands will make the turtle turn from the position in this screen to the next screen. Use the computer to check. Part a is done as an example.

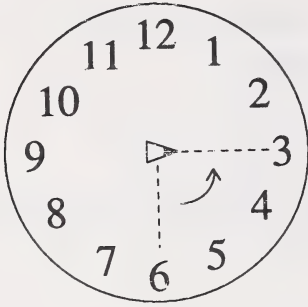


a.

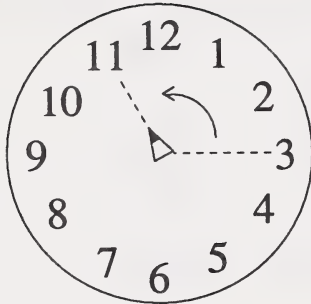
RIGHT 180



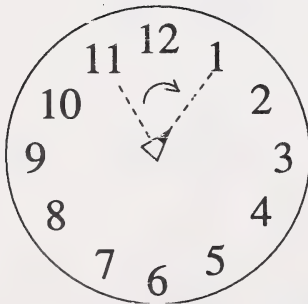
b.



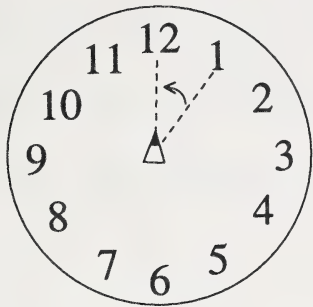
c.



d.



e.



See the appendix to check your answers.

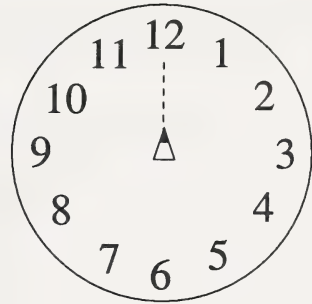
Exercise D: Drawing Line Segments

So far the turtle has not actually left a trail, a drawing. Let's actually make the turtle draw line segments and learn some more LOGO commands.

Is the turtle's nose facing 12 o'clock? If not, type this

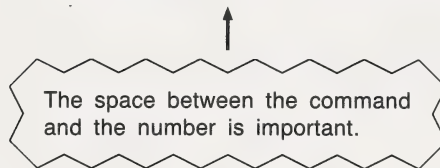
HOME <RETURN>

The turtle can only move in steps forward or back. Presently the turtle is pointing towards 12 o'clock.

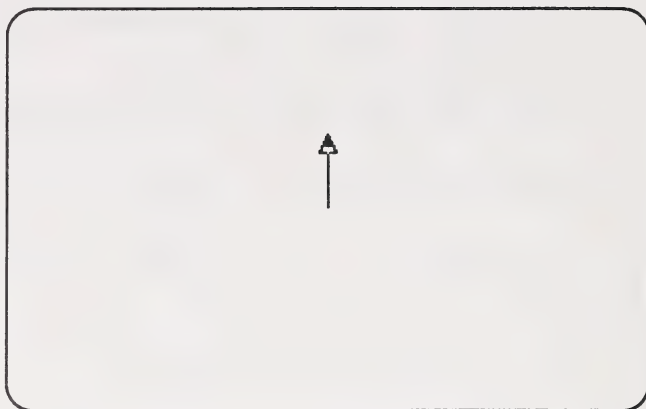


Let's move the turtle forward 30 steps. Type

FORWARD 30 <RETURN>



Notice that as the turtle moves it leaves a trail. The turtle has drawn a line segment that is 30 steps long.

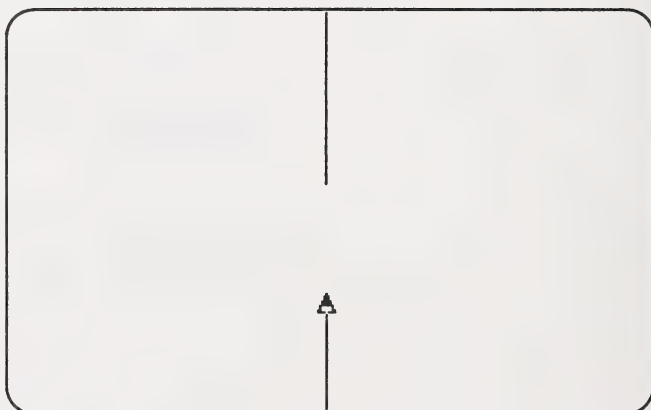


The distance the turtle moves when carrying out a **FORWARD** or **BACK** command is not based on any commonly used unit of measurement. Rather, it is based on the size of your computer monitor and the size of the programmable graphic points.

Notice that the draw screen is fairly small. What do you think will happen if you ask the turtle to move forward 150 steps? Try it. Type

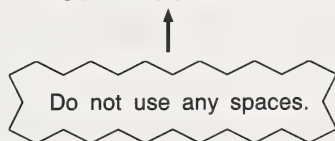
FORWARD 150 <RETURN>

The turtle disappears off the top of the draw screen and reappears at the bottom of the draw screen. This effect is called a **wrap around**.



Let's make a new drawing. Whenever you wish to make a new drawing, you must first clear the old drawing from the draw screen. Type

CLEARSCREEN <RETURN>

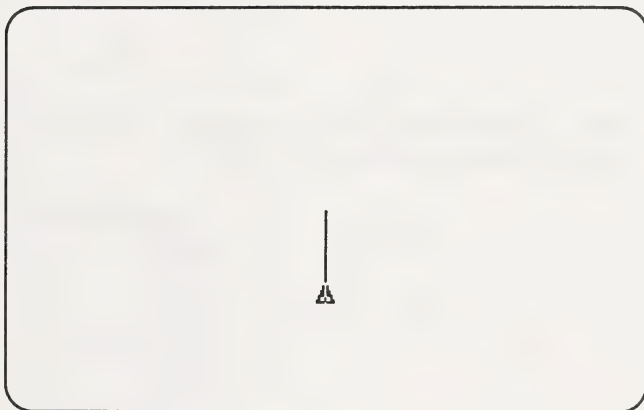


The drawing is removed and the turtle is returned to the home position.

Let's try moving the turtle back 50 steps. Type

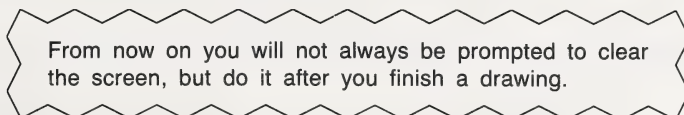
BACK 50 <RETURN>

The turtle moves back and leaves a trail.



Clear the draw screen once again. Do you remember how? Yes, type

CLEARSCREEN <RETURN>



Let's try using negative inputs. Type

FORWARD -25 **<RETURN>**

Notice that telling the turtle to move **FORWARD -25** is the same as telling it to move **BACK 25**.



Let's review the LOGO commands you have learned so far. All these commands except **HOME** have a short form.

SHOWTURTLE	ST
RIGHT	RT
LEFT	LT
HOME	
FORWARD	FD
BACK	BK
CLEARSCREEN	CS

Remember that **RIGHT**, **LEFT**, **FORWARD**, and **BACK** require numerical inputs.

The long form of these commands require quite a bit of typing and it's easy to make errors in typing. So you may prefer to use the short forms.

Experiment with the **FORWARD**, **BACK** commands now.

Exercise E: Drawing Angles

As you have discovered, the turtle moves when you give it a command it understands.

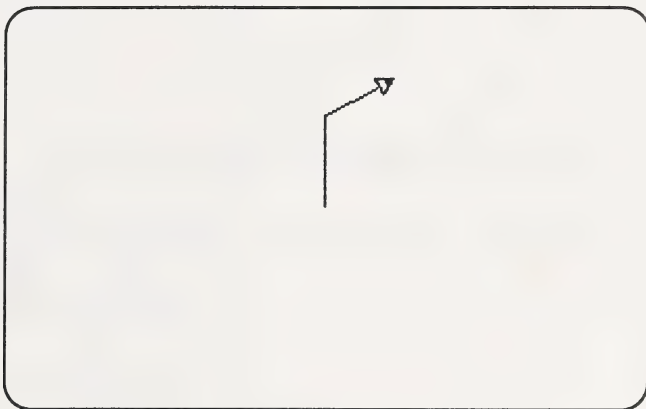
Let's make a little more complicated drawing. Let's draw an angle.

First examine your screen. Is the turtle in its home position? Is the draw screen clear? If not, use the **HOME** command and the **CS** command.

Then type this series of commands.

```
FD 50    <RETURN>
RT 60    <RETURN>
FD 30    <RETURN>
```

Your screen looks like this. It is an angle.



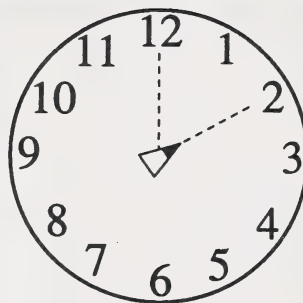
You told the turtle three things:

- the direction (**FORWARD**) to move and how far to move (**50** steps)
- the direction (**RIGHT**) to turn and how far to turn (**60** degrees)
- the direction (**FORWARD**) to move and how far to move (**30** steps)

Notice that the turtle moved forward 50 steps, turned right 60 degrees from the direction it was moving previously, and moved forward 30 steps.



Let's draw another angle. The turtle was facing 12 o'clock. Now it's facing 2 o'clock. First clear the screen and put the turtle in its home position.



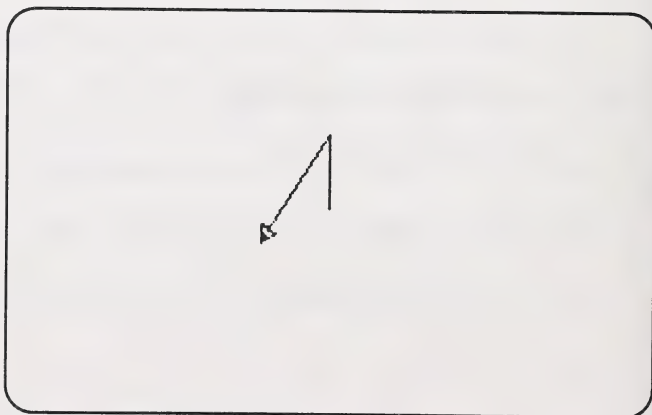
Let's use the **FD** and **LT** commands. Type

FD 40 <RETURN>

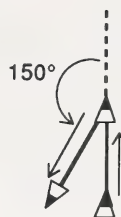
LT 150 <RETURN>

FD 60 <RETURN>

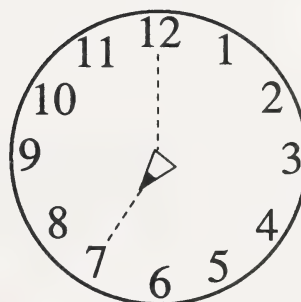
Your screen looks like this.



Notice that the turtle moved forward 40 steps, turned left 150 degrees from the direction it was previously moving, and moved forward 60 more steps.



The turtle was facing 12 o'clock. Now it is facing 7 o'clock.



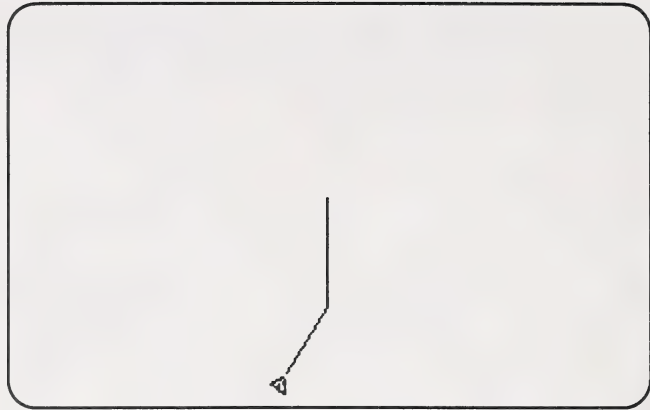
Let's make an angle using **BK** and **RT** commands. Be sure the screen is clear and the turtle is in its home position. Type

```

BK 60      <RETURN>
RT 30      <RETURN>
BK 50      <RETURN>

```

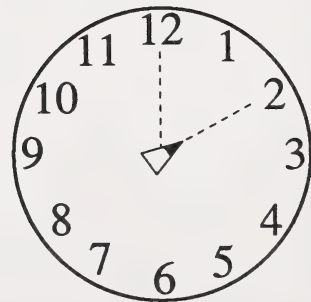
Your screen looks like this.



Notice that the turtle backed up 60 steps, turned right 30 degrees from the position it was travelling previously, and backed up 50 steps.



The turtle was facing 12 o'clock. Now it's facing 2 o'clock.



Practice making different angles.

Exercise F: Drawing Right Triangles

Let's begin drawing figures now. The first figure you will draw is a right triangle, a triangle with one 90-degree angle.

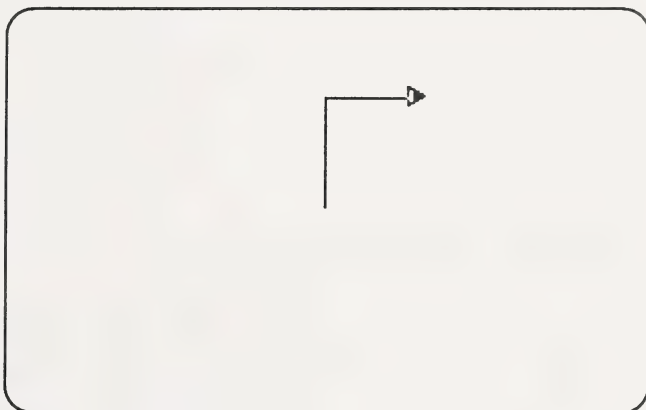
Begin by typing these commands.

FD 60 **<RETURN>**

RT 90 **<RETURN>**

FD 40 **<RETURN>**

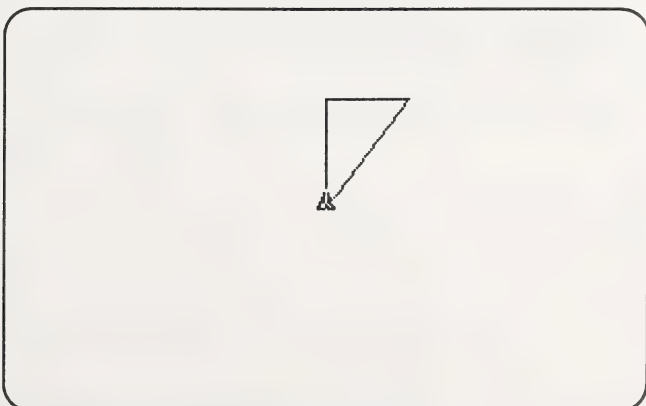
The screen looks like this. You need to tell the turtle to draw the third side of the triangle.



The easiest way to do this is to type

HOME **<RETURN>**

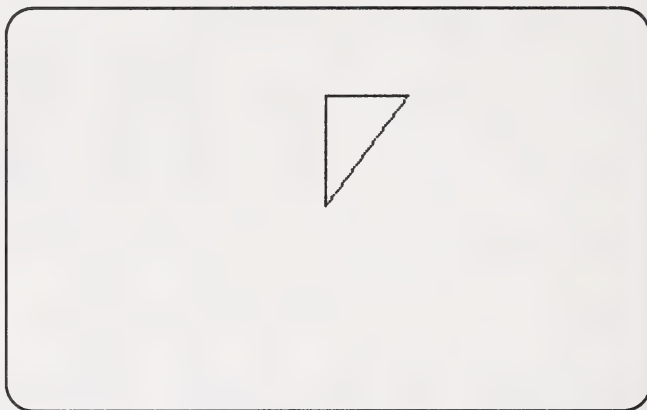
Notice that the turtle goes directly home and faces 12 o'clock. It has made a complete trip around the screen.



The turtle covers part of the figure. To make the turtle disappear use the **HIDETURTLE**, or **HT** command. Type

HT <RETURN>

The triangle can be seen more clearly.



Clear the screen and type

FD 60 <RETURN>

RT 90 <RETURN>

RT 40 <RETURN>

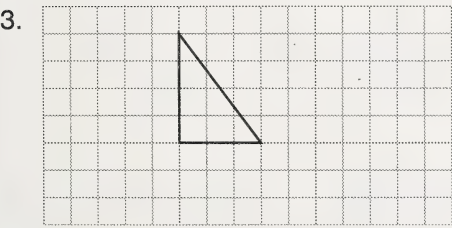
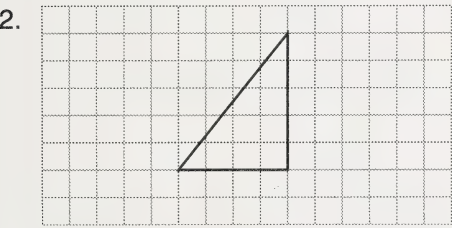
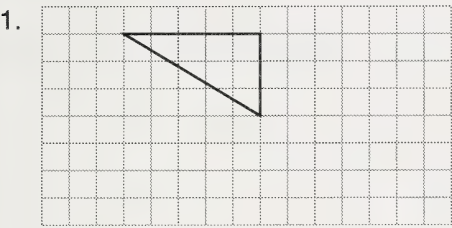
HOME <RETURN>

Notice the triangle is drawn, but the turtle is not visible. If you can't see the turtle, it is harder to correct errors.

To make the turtle appear, use the **SHOWTURTLE**, or **ST** command. Type

ST <RETURN>

Make the following right triangles using LOGO and a computer. One grid space equals 10 turtle steps. Write your commands in the space at the right



See the appendix to check your answers.

Exercise G: Drawing Regular Triangles

Regular triangles, triangles with congruent sides and congruent angles, are often used in designs.

Let's try drawing a regular triangle with sides of 40 steps. Type

BK 40 **<RETURN>**

LT 120 **<RETURN>**

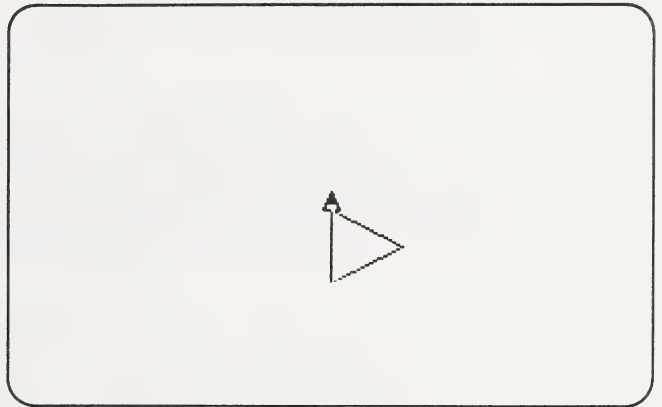
BK 40 **<RETURN>**

LT 120 **<RETURN>**

BK 40 **<RETURN>**

LT 120 **<RETURN>**

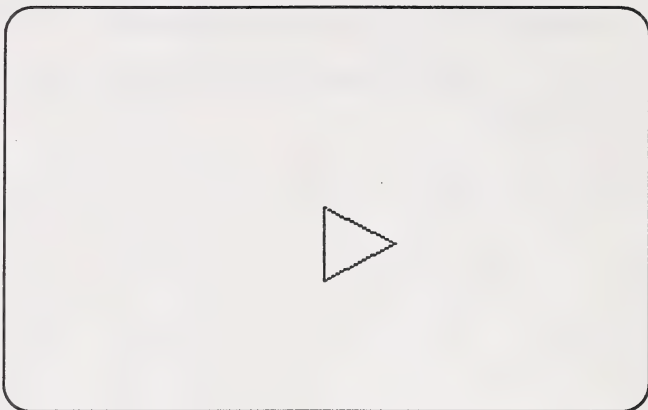
The turtle draws a regular triangle with sides of 40 steps.



It is difficult to tell if the third side actually meets the first side because the turtle covers the corner of the figure. To check, tell the turtle to disappear. Do you remember the command? Type

HT **<RETURN>**

The turtle disappears and the figure is seen clearly.

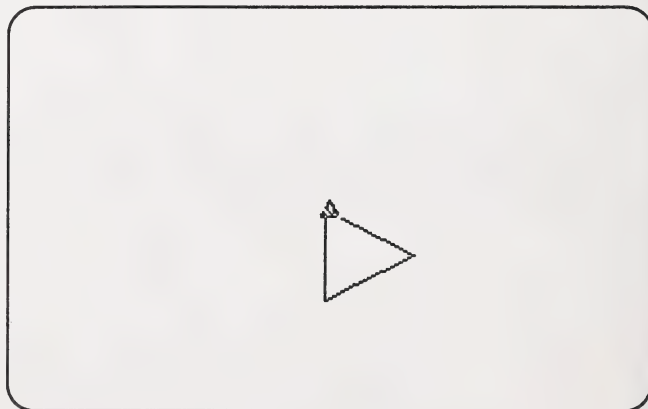


Let's draw another regular triangle. Clear the screen and make the turtle reappear. Then type

FD 50 RT 120 FD 50 RT 120 FD 50 RT 120 <RETURN>

Notice that **<RETURN>** is **not** pressed after every command. Instead it is pressed once after all the commands are typed. Also notice that spaces are required between commands.

The turtle quickly draws a triangle.



Did you notice when you typed the commands for this triangle that two commands were repeated three times?

FD 50 RT 120 FD 50 RT 120 FD 50 RT 120 <RETURN>

You can also draw this triangle using the **REPEAT** command. Type

REPEAT 3[FD 50 RT 120] <RETURN>

Some older APPLE computers do not have keys with square brackets. If you are working on one of these keyboards, try holding down the **SHIFT** key and pressing **N** to make [. Try holding down the **SHIFT** key and pressing **M** to make].

Examine this command for another triangle.

BK 40 LT 120 BK 40 LT 120 BK 40 LT 120 <RETURN>

It has 3 groups of **BK 40 LT 120**.

How would you tell the turtle to draw this triangle using the **REPEAT** command? You would type

REPEAT 3[BK 40 LT 120]

Experiment drawing regular triangles using the **REPEAT** command.

Exercise H: Drawing Squares

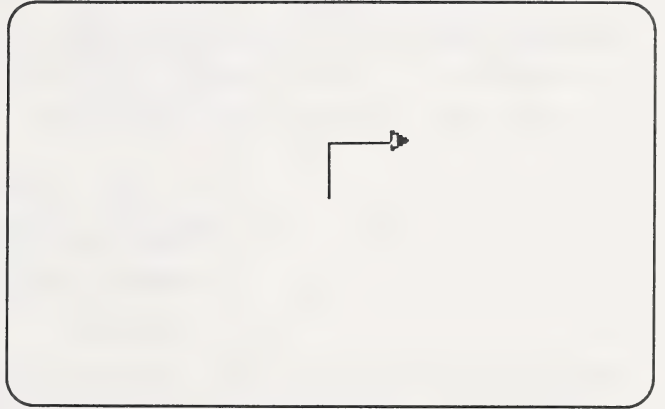
Now let's draw a square. Begin by typing these commands.

FD 30 **<RETURN>**

RT 90 **<RETURN>**

FD 30 **<RETURN>**

The turtle draws this right angle.
This is the first two sides of the square.

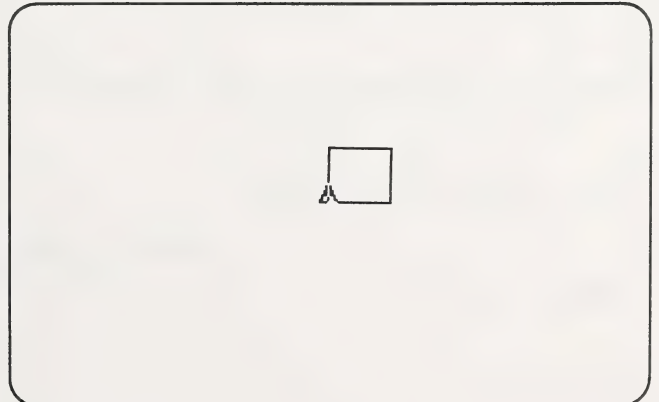


Tell the turtle to draw the rest of the square. Be sure the turtle makes the entire trip around the screen and ends up in the home position.

Experiment at the computer until you solve this problem.

.

Did the turtle draw the square and
return to the home position?



If so, congratulations! You've drawn your first square. If not, type these commands.

```
RT 90    <RETURN>
FD 30    <RETURN>
RT 90    <RETURN>
FD 30    <RETURN>
RT 90    <RETURN>
```

Altogether with the 3 commands you typed previously, you gave the turtle 8 commands. You told it to draw 4 sides and 4 corners.

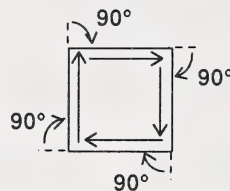
You could also have typed these commands.

```
RT 90    <RETURN>
FD 30    <RETURN>
HOME      <RETURN>
```

Altogether with the 3 commands you typed previously, you gave the turtle only 6 commands. It drew the fourth side and turned the corner as it went home.

Note the turtle moved forward 30 steps, turned right 90 degrees, and repeated this sequence 4 times. It made the total trip of 360 degrees around the screen.

$$90 + 90 + 90 + 90 = 360$$



Now try to draw a square using the **FD**, **RT**, and **REPEAT** commands.

.

Did you type this command?

```
REPEAT 4[FD 30 RT 90]
```

Good!

Now let's draw a square with sides of 50 steps using only the **BK** and **LT** commands.

.

Did you type these commands?

```
BK 50    <RETURN>
LT 90    <RETURN>
BK 50    <RETURN>
LT 90    <RETURN>
BK 50    <RETURN>
```

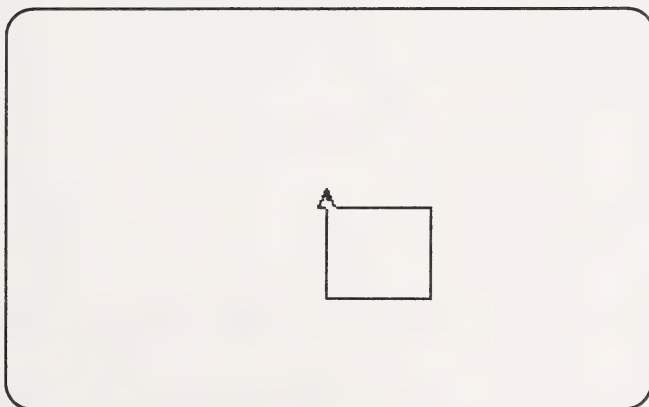
and then either these commands

```
LT 90    <RETURN>
BK 50    <RETURN>
LT 90    <RETURN>
```

or this command.

```
HOME     <RETURN>
```

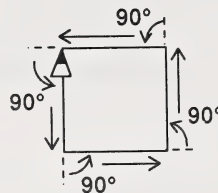
Good! Your square looks like this.



Note

When you draw the square it made the total trip around the screen. That is, the turtle started and ended in the same position.

$$90 + 90 + 90 + 90 = 360$$



Now try to draw the square using the **BK**, **LT**, and **REPEAT** commands.

.

Did you type this?

REPEAT 4[BK 50 LT 90]

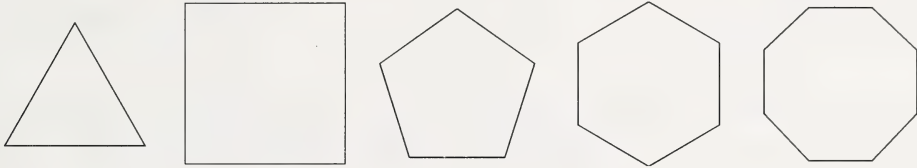
Good!

Now experiment drawing different sizes of squares.

Exercise I: Drawing Circles

You have drawn triangles and squares. Let's draw a circle now.

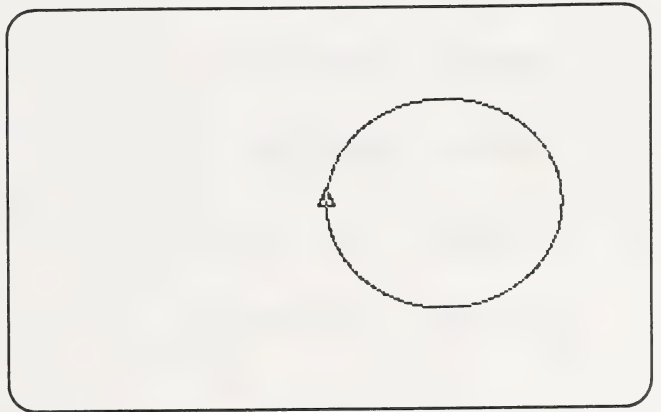
You have seen that the turtle makes a total trip of 360 degrees around the screen when it makes a figure like a triangle or a square. Notice that the more sides a figure has, the more it looks like a circle.



If the turtle draws a figure with 360 sides it will look very much like a circle. It will make 360 turns of 1 degree to move around the screen and return home. Type

REPEAT 360[FD 1 RT 1] <RETURN>

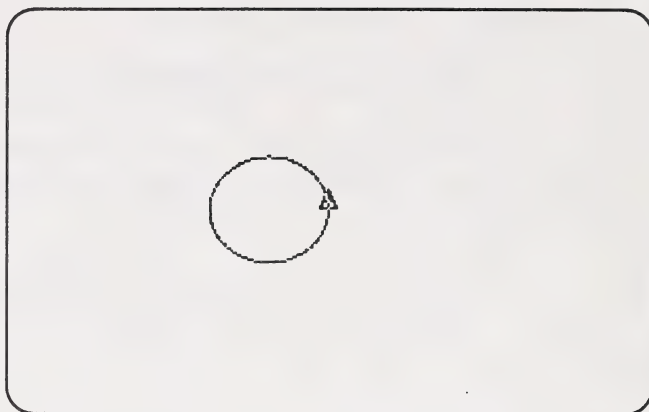
Sure enough the turtle draws what appears to be a circle.



If the turtle draws a figure with 180 sides it will still look like a circle. It will make 180 turns of 2 degrees to make the total trip. Type

REPEAT 180[BK 1 LT 2] <RETURN>

Again the turtle draws a circle. This circle is smaller and is on the left side of the screen.



1. Here are more commands to draw circles. What number goes in each of the blanks? Experiment at the computer.
 - a. **REPEAT 120[FD 1 RT ____]**
 - b. **REPEAT 90[BK 1 LT ____]**
 - c. **REPEAT 72[FD 1 RT ____]**
 - d. **REPEAT ____ [BK 1 LT 10]**
 - e. **REPEAT ____ [FD 1 RT 20]**
2. What happens to the size of the circle as you decrease the angle of the turns?

Try typing each of these commands. Clear the screen after each command.

REPEAT 90[FD 1 RT 4]

REPEAT 90[FD 2 RT 4]

REPEAT 90[BK 3 LT 4]

REPEAT 90[BK 4 LT 4]

3. What happens to the size of the circle when you increase the **FD** and **BK** numbers and keep the other numbers the same? Experiment at the computer.



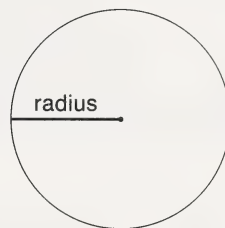
See the appendix to check your answers.

Exercise J: Using the CIRCLES and CIRCLE Commands

You can draw circles using the **CIRCLES** (pronounced Circle R) and **CIRCLE** (pronounced Circle L) commands.

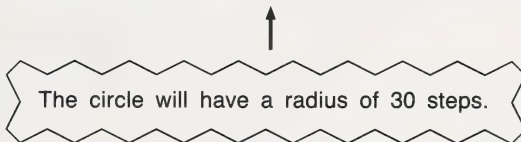
CIRCLES makes the turtle travel to its right to draw a circle. **CIRCLE** makes the turtle travel to its left to draw a circle.

CIRCLES and **CIRCLE** require numbers after them. The number refers to the size in turtle steps of the radius of the circle. (The radius is the distance from the centre to the outside of the circle.)

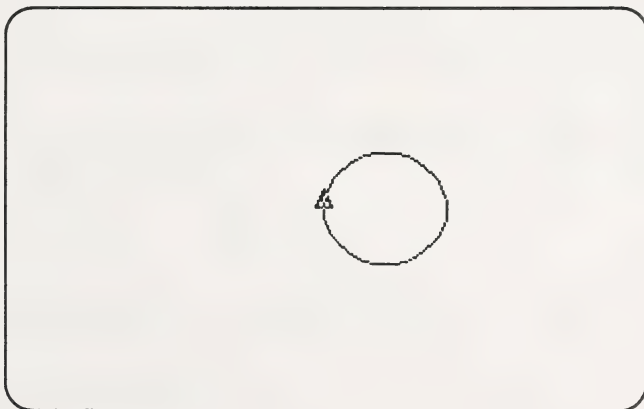


Let's try making circles using these commands. Type

CIRCLES 30 <RETURN>



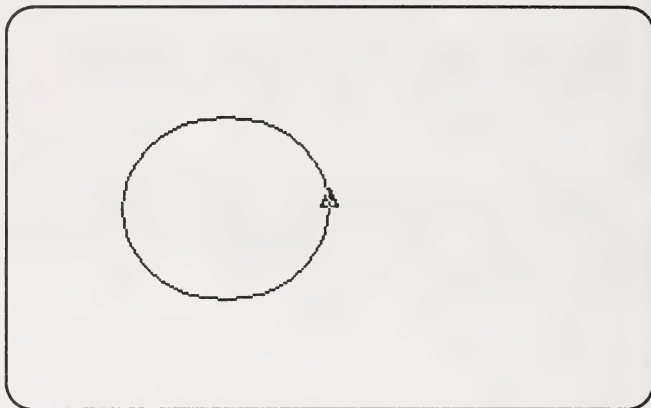
The screen looks like this.



Clear the screen and type this command.

CIRCLEL 50 <RETURN>

The screen looks like this. The circle is larger and is on the left side of the screen.



Experiment drawing circles of different sizes.

Exercise K: Creating Procedures

It would be nice to have a single command for drawing a triangle or a square, wouldn't it? The turtle doesn't have such commands built in. However, LOGO allows you to teach the turtle new commands. This is called **creating a procedure**.

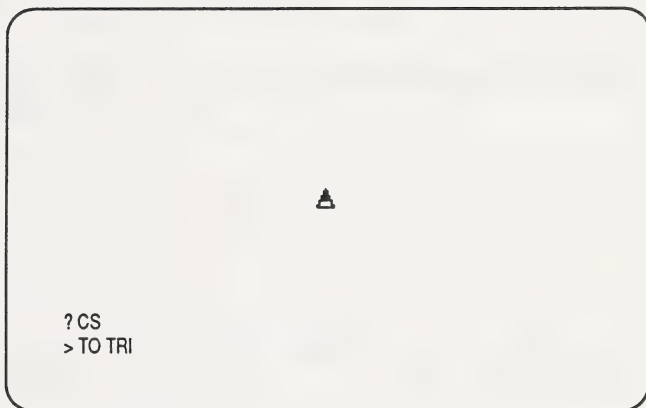
Let's begin by creating a procedure to draw a triangle. Earlier you made a regular triangle with sides of 50 steps by typing

```
REPEAT 3[FD 50 RT 120]    <RETURN>
```

You can teach the turtle to draw this triangle when you type **EQTRI**. To do this type

```
TO EQTRI    <RETURN>
```

Notice that the prompt changes from a question mark to an angle bracket (>). This means that the turtle is learning this command.



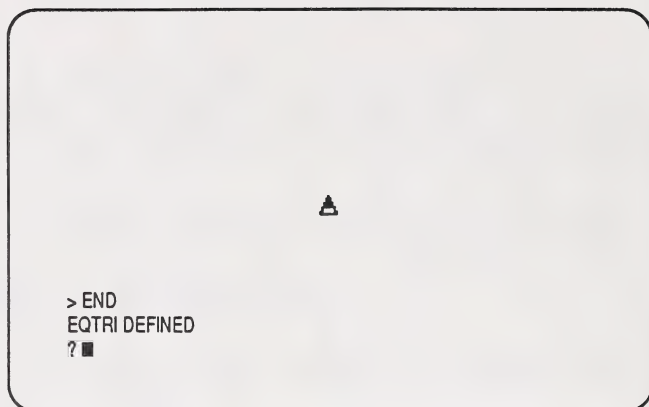
Now type the commands for drawing a triangle with sides of 50 steps. Type these commands carefully. Be sure you don't make a mistake.

```
REPEAT 3[FD 50 RT 120]    <RETURN>
```

Notice that the turtle does not perform this command. It is still learning. You must tell the turtle you have completed giving the commands for drawing the triangle. Type

```
END    <RETURN>
```


Notice the message — **EQTRI DEFINED** appears on the screen. Then the prompt changes to a question mark.

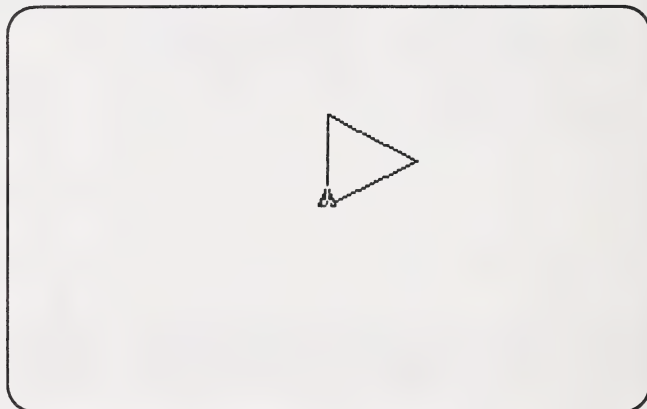


There you are! The turtle knows the procedure **EQTRI**.

Let's try the procedure. Type

EQTRI <RETURN>

The turtle draws a triangle with sides of 50 steps.



Note

The computer will only remember the procedures you have created while you are working at the computer. When you turn the computer off, it will forget the procedure. (It is possible to save procedures using a file diskette. You may wish to learn about this later on your own. We won't deal with it in this booklet.)

If you make a mistake defining a procedure to the turtle, it will not know the difference. Therefore it is very important that you type the procedure carefully. It is helpful to experiment before you actually type **TO** and the name of the procedure, so you can write down the commands and instruct the turtle correctly. (LOGO does have an edit mode but we won't be using it in this booklet.)

1. Write a procedure for a square with sides of 30 steps. Name it **SQ**.
2. Write a procedure for a rectangle with sides of 10 steps and 50 steps. Name it **RECT**.



See the appendix to check your answers.

Exercise L: Procedures with Variables

You have learned that in order to make the turtle draw a square on the screen, you can use a procedure.

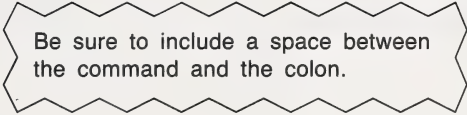
```
TO SQUARE  
REPEAT 4[FD 30 RT 90]  
END
```

Now, every time you type **SQUARE** the turtle draws a square with a side of 30 steps in length. Suppose you wanted to make a larger square, what changes would you have to make to this procedure? Or, to get a smaller square, would you have to write another procedure?

There is a way that you can make the turtle draw squares of different sizes without having to write a new procedure every time. You can write one procedure with a variable in it. A **variable** is a symbol that represents any number that you choose.

Here is a procedure that will move forward and right to draw different-sized squares. In this procedure, the variable is **S**.

```
TO SQUARER  
REPEAT 4[FD :S RT 90]  
END
```

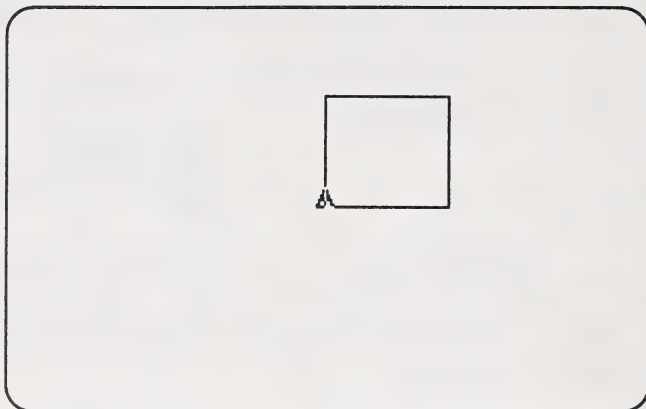


Be sure to include a space between the command and the colon.

Let's try this procedure. Let's draw a square with sides of 60 steps. Type

```
SQUARER 60    <RETURN>
```

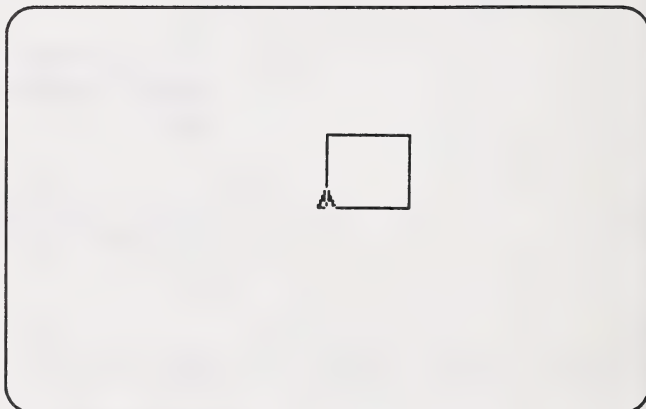
The turtle draws a square with sides of 60 steps.



Now let's try drawing a square with sides of 40. Clear the screen. Type

SQUARER 40 <RETURN>

The turtle draws a square with sides of 40 steps.



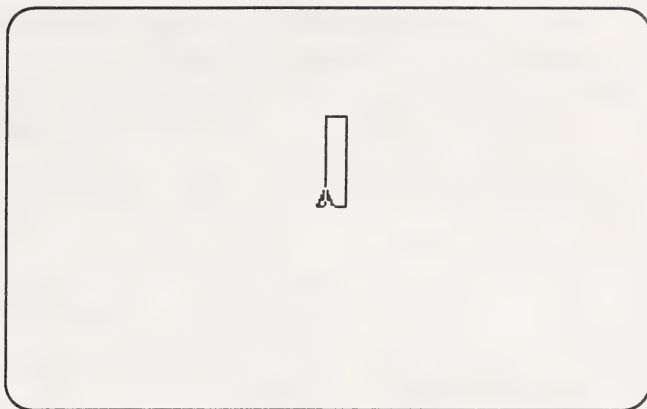
Some procedures have two variables. Type

```
TO RECTANGLER :L :W      <RETURN>
REPEAT 2[FD :L RT 90 FD :W RT 90] <RETURN>
END                       <RETURN>
```

Now let's try the procedure. Type

RECTANGLER 50 10 <RETURN>

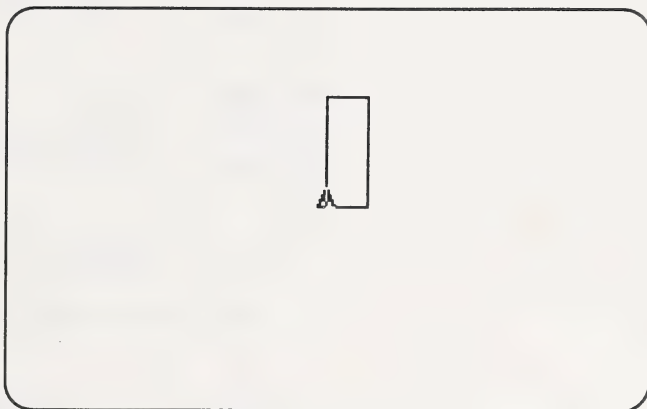
The turtle draws a rectangle with length of 50 steps and width of 10 steps.



Now let's try drawing another rectangle. Type

RECTANGLER 60 20 **<RETURN>**

The turtle draws a rectangle with length 60 steps and width of 10 steps.



1. Write a procedure using a variable to tell the turtle to move **FD** and **LT** and to draw a square. Name it **SQUAREL**.
2. Write procedures using a variable for drawing triangles with congruent sides. Name them **EQTRIR** and **EQTRIL**.



See the appendix to check your answers.

Exercise M: Move Designs

Now that you have learned the **CIRCLER** and **CIRCLEL** commands and how to create procedures to draw triangles and squares, you are ready to make some designs.

If you have turned off the computer since the last activity, you will have to teach the computer these procedures. Type

```
TO SQUARER :S          <RETURN>
REPEAT 4[FD :S RT 90]  <RETURN>
END                    <RETURN>
```

```
TO SQUAREL :S          <RETURN>
REPEAT 4[FD :S LT 90]  <RETURN>
END                    <RETURN>
```

```
TO EQTRIR :S            <RETURN>
REPEAT 3[FD :S RT 120] <RETURN>
END                    <RETURN>
```

```
TO EQTRIL :S            <RETURN>
REPEAT 3[FD :S LT 120] <RETURN>
END                    <RETURN>
```

Be sure you type carefully and test each procedure.

The following design can be made with these procedures.

First type.

```
SQUARER 10  <RETURN>
SQUARER 20  <RETURN>
SQUARER 30  <RETURN>
SQUARER 40  <RETURN>
SQUARER 50  <RETURN>
```

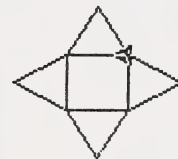
The turtle draws this design.



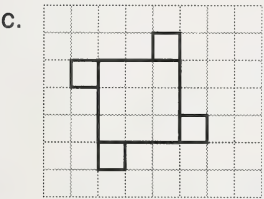
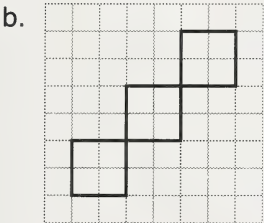
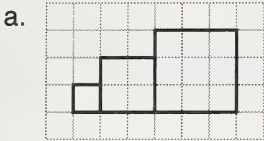
Next type.

SQUARER 30	< RETURN >
EQTRIL 30	< RETURN >
RT 90	< RETURN >
EQTRIR 30	< RETURN >
FD 30 RT 90	< RETURN >
EQTRIR 30	< RETURN >
FD 30 RT 90	< RETURN >
EQTRIR 30	< RETURN >

The turtle draws this design.



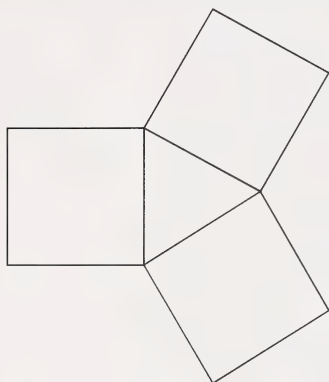
1. Tell the turtle to draw each of these designs. Write your commands in the space provided. Remember there are many different ways to do each. One grid space equals 10 turtle steps.



2. Tell the turtle to draw this design. The triangles have sides of 10 steps, 30 steps, and 50 steps.



3. Draw this design. The squares all have sides of 30 steps.



See the appendix to check your answers.

Exercise N: Using the PENUP and PENDOWN Commands

You are now going to make designs that require the turtle to move from one point to another without leaving a trail.

If you have turned off the computer since the last activity you will have to teach the computer these procedures. Type

```
TO SQUARER :S      <RETURN>
REPEAT 4[FD :S RT 90] <RETURN>
END                <RETURN>
```

```
TO SQUAREL :S     <RETURN>
REPEAT 4[FD :S LT 90] <RETURN>
END                <RETURN>
```

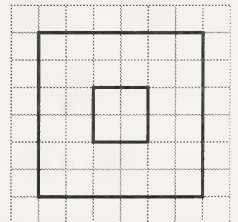
```
TO EQTRIR :S       <RETURN>
REPEAT 3[FD :S RT 120] <RETURN>
END                <RETURN>
```

```
TO EQTRIL :S       <RETURN>
REPEAT 3[FD :S LT 120] <RETURN>
END                <RETURN>
```

Be sure you type carefully and test each procedure.

The **PENUP** or **PU** and **PENDOWN** or **PD** commands let you lift up or put down the turtle's pen.

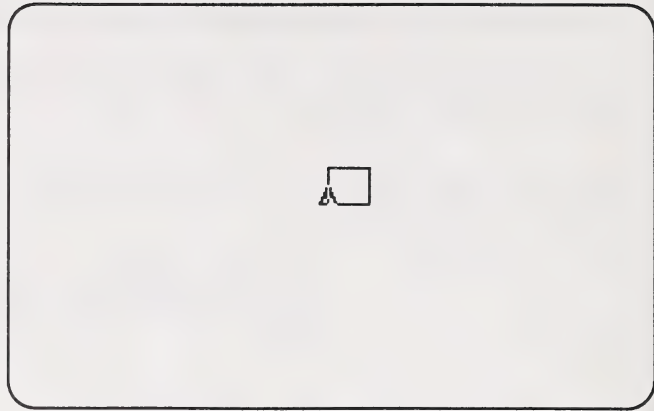
Look at this design. It has a square inside a square. One grid space will equal 10 turtle steps.



Let's start by drawing the smaller square. Type

```
SQUARER 20      <RETURN>
```

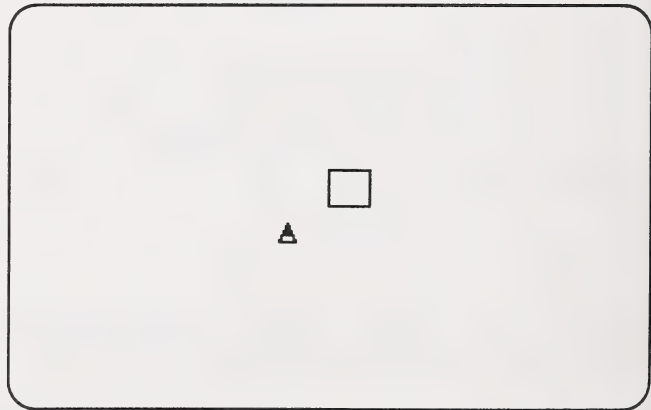

Your screen looks like this.



Now let's tell the turtle to lift the pen up off the screen and move to the next position you want it to begin to draw again. Next, let's tell the turtle to put the pen down again. Type

```
PU          <RETURN>
BK 20 LT 90 <RETURN>
FD 20 RT 90 <RETURN>
PD
```

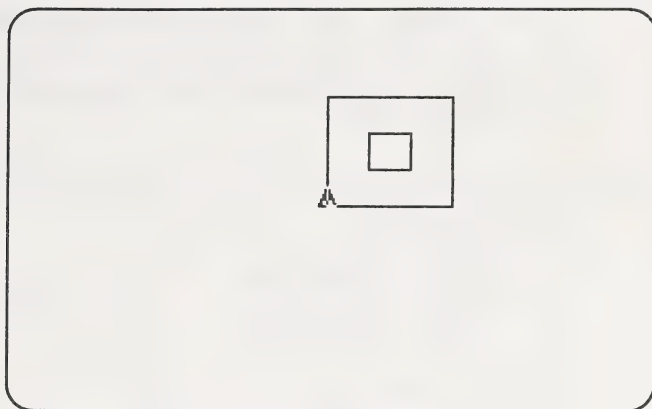
Your screen now looks like this. The turtle has moved to this position without leaving a trail.



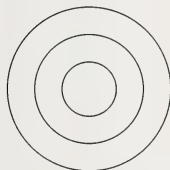
Now let's tell the turtle to draw the bigger square. Type

```
SQUARER 60  <RETURN>
```

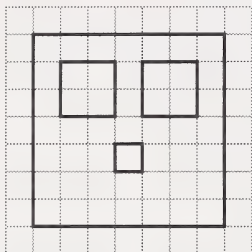
Your screen looks like this. The design is drawn correctly.



1. Tell the turtle to draw a design like the following. It has circles with radii of 10, 20, and 30. Write your commands in the space provided.



2. Tell the turtle to draw a design like the following. One grid space equals 10 turtle steps. Use LOGO and your computer to solve these problems. (Remember there are many ways to command the turtle to make these designs. Write your commands in the space provided.)



See the appendix to check your answers.

Exercise O: More Move Designs

Let's make more move designs using the computer. These move designs will use the **PU** and **PD** commands.

If you have turned the computer off since the last activity, you will have to teach the computer these procedures. Type

```
TO SQUARER :S          <RETURN>
REPEAT 4[FD :S RT 90]  <RETURN>
END                     <RETURN>
```

```
TO SQUAREL :S          <RETURN>
REPEAT 4[FD :S LT 90]  <RETURN>
END                     <RETURN>
```

```
TO EQTRIR :S            <RETURN>
REPEAT 3[FD :S RT 120] <RETURN>
END                     <RETURN>
```

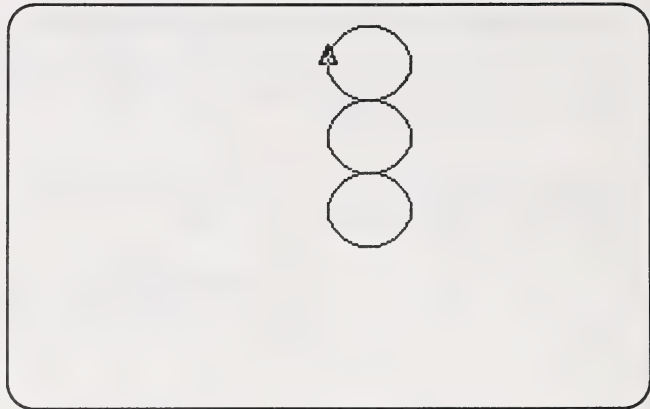
```
TO EQTRIL :S            <RETURN>
REPEAT 3[FD :S LT 120] <RETURN>
END                     <RETURN>
```

Be sure you type carefully and test each procedure.

Here's a move design. Type

```
CIRCLER 20              <RETURN>
PU FD 40 PD              <RETURN>
CIRCLER 20              <RETURN>
PU FD 40 PD              <RETURN>
CIRCLER 20              <RETURN>
PU FD 40 PD              <RETURN>
```

The turtle draws a stack of circles.



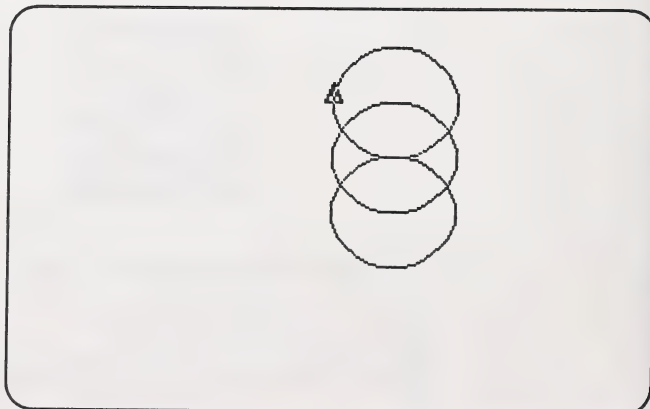
This design could have been created using a **REPEAT** command because the first 2 lines are repeated 3 times. Type

REPEAT 3[CIRCLER 20 PU FD 40 PD] <RETURN>

The same design is drawn.

CIRCLER 30	<RETURN>
PU FD 30 PD	<RETURN>
CIRCLER 30	<RETURN>
PU FD 30 PD	<RETURN>
CIRCLER 30	<RETURN>
PU FD 30 PD	<RETURN>

The turtle draws these overlapping circles.



Again this design could have been created with a **REPEAT** command. Type

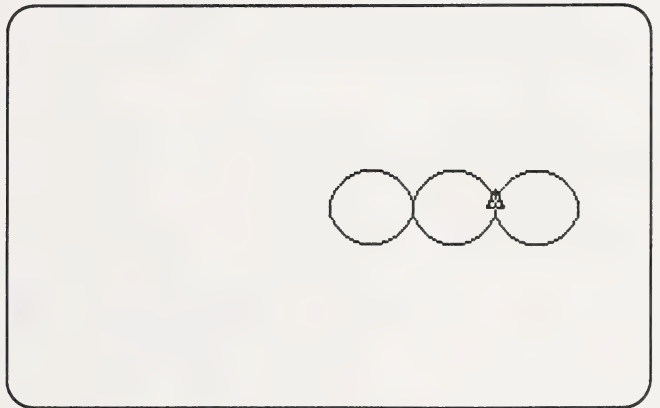
REPEAT 3[CIRCLER 30 PU FD 30 PD] <RETURN>

How would you make a row of circles?

Here's one way. Type

CIRCLER 20	<RETURN>
PU RT 90 FD 40 LT 90 PD	<RETURN>
CIRCLER 20	<RETURN>
PU RT 90 FD 40 LT 90 PD	<RETURN>
CIRCLER 20	<RETURN>
PU RT 90 FD 40 LT 90 PD	<RETURN>

The turtle draws a row of circles.



Again a **REPEAT** command could have been used. Type

REPEAT 3 [CIRCLER 20 PU RT 90 FD 40 LT 90 PD] <RETURN>

1. Tell the turtle to draw this design. The circles have radii of 24, 14, and 8 steps.



2. Tell the turtle to draw this design. The circles have radii of 8, 14, and 24 steps.

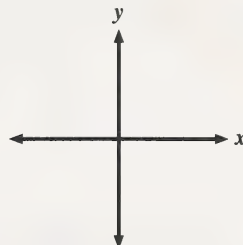


See the appendix to check your answers.

Exercise P: Using SETX and SETY

Everything you have done in this booklet so far has used the turtle commands — **FD**, **BD**, **RT**, **LT**.

You can also tell the turtle to move to an exact position on the screen using X- and Y-coordinates. X- and Y-coordinates are measured from the centre of the screen. You can think of the home position as the origin of a graph.



To tell the turtle to move directly to a position use **SETX** and **SETY**. **SETX** gives the x (horizontal) position. **SETY** gives the y (vertical) position.

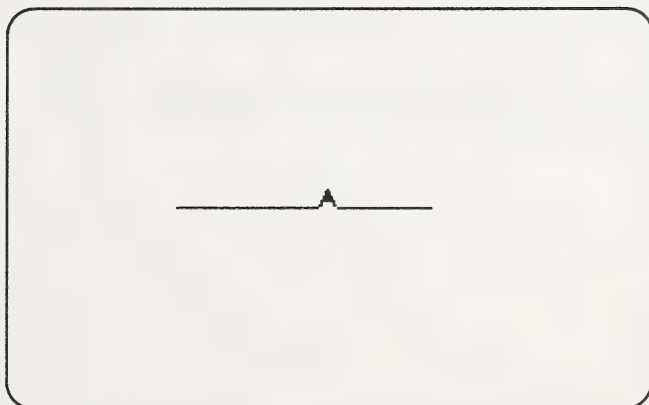
Positive values of x move the turtle to the right half of the screen. Negative values of x move the turtle to the left half of the screen.

Positive values of y move the turtle to the upper half of the screen. Negative values of y move the turtle to the lower half of the screen.

Try using **SETX** and **SETY**. Type

SETX 50	<RETURN>
SETX -90	<RETURN>
HOME	<RETURN>

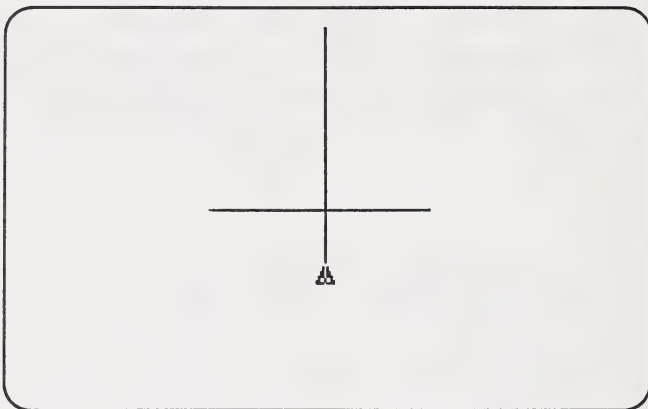
The turtle moves 50 steps to the right of **HOME**, 90 steps to the left of home and then **HOME**. Notice the turtle doesn't change its heading. It continues to point upwards.



Do not clear the screen. Type

```
SETX 100    <RETURN>
SETX -40    <RETURN>
```

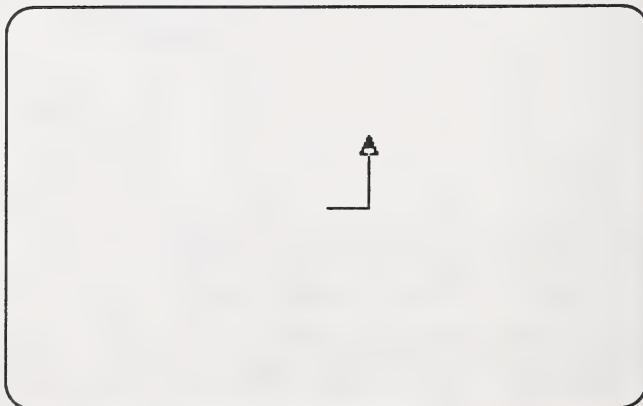
The turtle moves directly up 100 steps from home and directly down 40 steps from home.



Now clear the screen and type

```
SETX 20    <RETURN>
SETY 30    <RETURN>
```

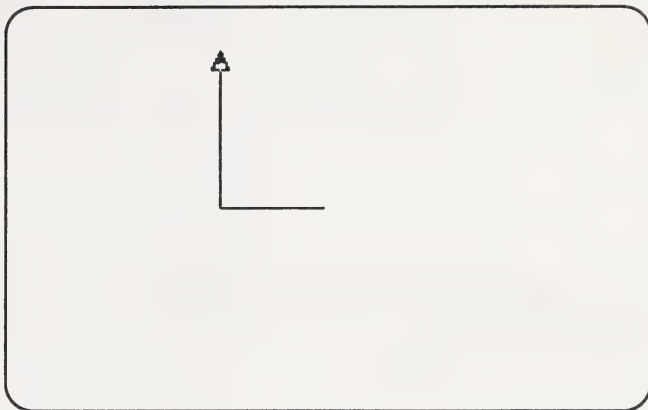
Notice the turtle goes to (20,30) on the screen.



Now clear the screen and type

```
SETX -50  <RETURN>
SETY 75   <RETURN>
```

Notice the turtle goes to (-50,75) on the screen.

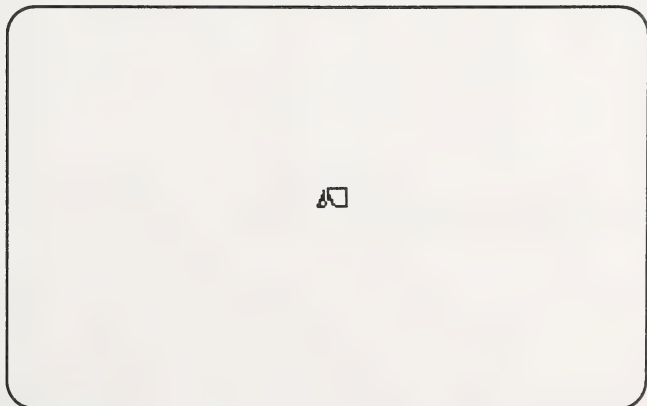


You can use the **PU** and **PD** commands to move to any position on the screen without leaving a trail.

First let's draw a square with sides of 10 steps so you can remember where home is. Clear the screen and type

```
SQUARER 10  <RETURN>
OR
REPEAT 4[FD 10 RT 90]  <RETURN>
```

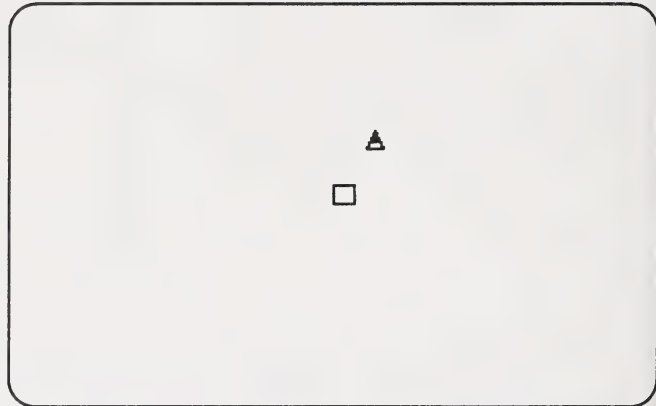
The turtle draws a square.



Now type

```
PU      <RETURN>
SETX 20 <RETURN>
SETY 30 <RETURN>
PD      <RETURN>
```

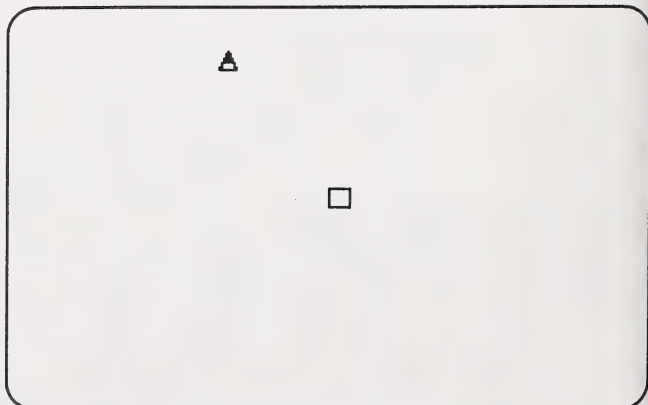
The turtle moves to (20,30) without leaving a trail.



Don't clear the screen. Type

```
PU      <RETURN>
SETX -50 <RETURN>
SETY 75 <RETURN>
PD      <RETURN>
```

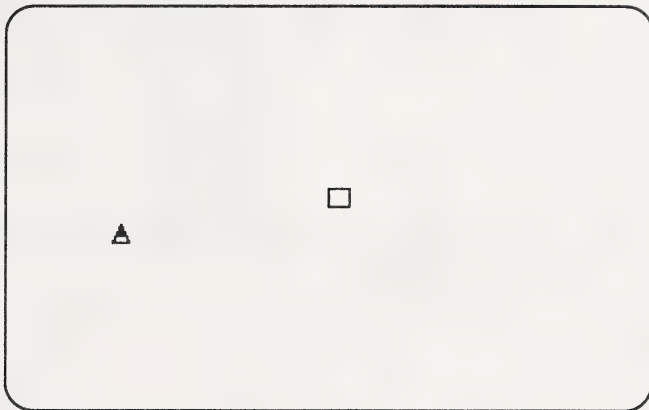
The turtle moves to (-50,75).



Don't clear the screen. Type

```
PU      <RETURN>
SETX -100 <RETURN>
SETY -20 <RETURN>
PD      <RETURN>
```

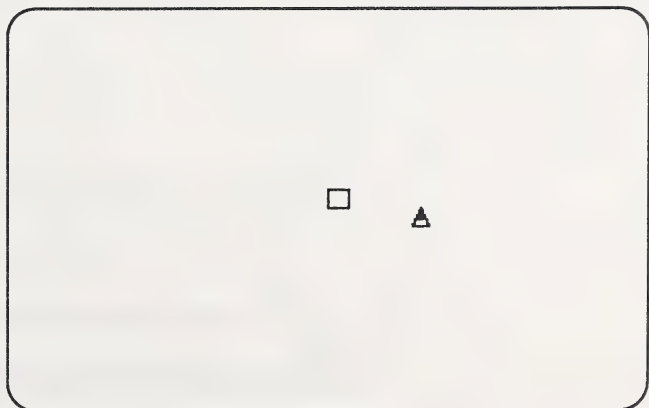
The turtle moves to (-100,-20).



Don't clear the screen. Type

```
PU      <RETURN>
SETX 45  <RETURN>
SETY -10 <RETURN>
PD      <RETURN>
```

The turtle moves to (45,-10).



1. Tell the turtle to move to $(-100,80)$ without leaving a trail and draw a square with sides of 20 steps.
2. Tell the turtle to move to $(90,-30)$ without leaving a trail and draw a rectangle with length of 30 and width of 10 steps.
3. Tell the turtle to move to $(-30,-30)$ without leaving a trail and draw a triangle with sides of 50 steps.
4. Tell the turtle to move to $(-100,80)$ without leaving a trail and draw a row of 10 squares with sides of 20 steps.
5. Tell the turtle to move to $(0,-50)$ without leaving a trail and draw a stack of 3 squares with sides of 50 steps.



See the appendix to check your answers.

Exercise Q: Spin Designs

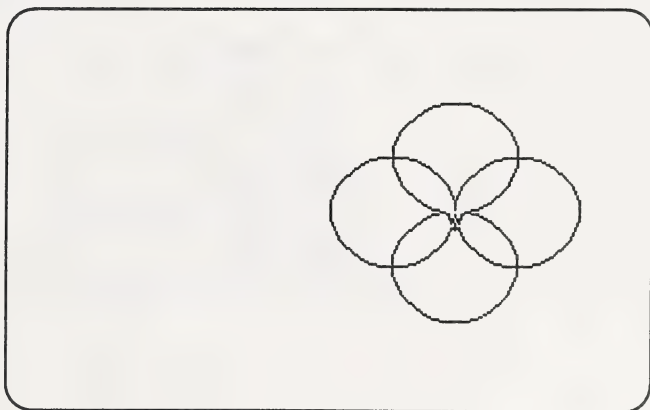
Let's make some spin designs using the computer. A spin design involves drawing a figure, turning the turtle to the right, and repeating the process until the turtle has made a total trip around the screen.

Here's a circle spin design. Type

```
CIRCLER 30    <RETURN>
RT 90         <RETURN>
CIRCLER 30    <RETURN>
RT 90         <RETURN>
CIRCLER 30    <RETURN>
RT 90         <RETURN>
CIRCLER 30    <RETURN>
RT 90         <RETURN>
```

The turtle draws this design and ends up where it began.

$$4 \times 90 = 360$$



Notice that the first two lines are repeated 4 times. The design can be made using a **REPEAT** command. Type

```
REPEAT 4[CIRCLER 30 RT 90]    <RETURN>
```

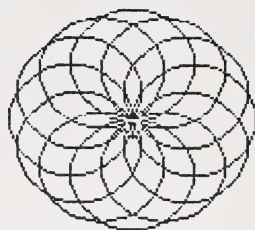
The turtle draws the same design.

Let's see what happens when you increase the number of repeats. Type

```
REPEAT 12[CIRCLER 30 RT 30]   <RETURN>
```

Remember, $12 \times 30 = 360$. So the turtle will make the total trip.

The turtle draws this design.



You can make spin designs that include the **PU** and **PD** commands. Type

CIRCLER 10	<RETURN>
PU RT 90 FD 40 PD	<RETURN>
CIRCLER 10	<RETURN>
PU RT 90 FD 40 PD	<RETURN>
CIRCLER 10	<RETURN>
PU RT 90 FD 40 PD	<RETURN>
CIRCLER 10	<RETURN>
PU RT 90 FD 40 PD	<RETURN>

The turtle draws 4 separate circles.



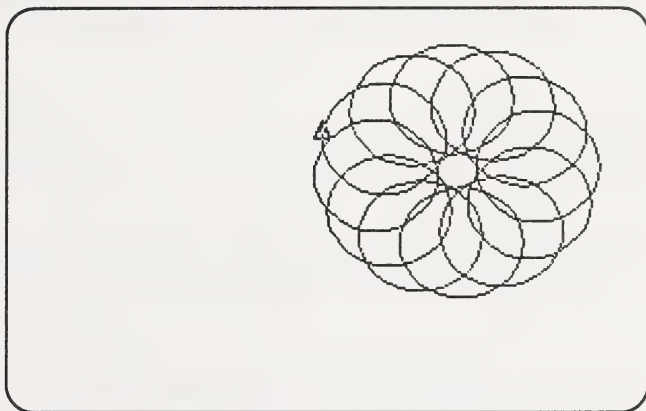
Let's try increasing the number of repeats and the size of the circles. Type

REPEAT 12[CIRCLER 30 PU RT 30 FD 35 PD] <RETURN>

An interesting design is drawn but it runs into the commands. Try using **SETY** to raise the design. Type

PU SETY 70 PD <RETURN>
REPEAT 12[CIRCLER 30 PU RT 30 FD 35 PD] <RETURN>

The turtle draws the same design higher on the screen.



1. Tell the turtle to spin a triangle, with sides of 50 steps, 18 times.
2. Tell the turtle to spin a triangle, with sides of 50 steps, 10 times. Have the turtle lift the pen and move 30 steps forward between drawing each triangle.

3. Tell the turtle to spin a square, with sides of 30 steps, 9 times.
4. Tell the turtle to spin a square, with sides of 30 steps, 6 times. Have the turtle lift the pen and move forward 25 steps between drawing each square.



See the appendix to check your answers.

Summary

In this booklet you have been using built-in commands to draw figures and designs. You also have learned a little about writing procedures and using these procedures to make designs.

We think you will agree that LOGO is an easy and fun computer language to learn and use.

Let's review the commands you learned in this booklet. They're listed alphabetically.

Commands

BACK (BK)	Tells the turtle to move back. A number is needed to tell how many steps.
CIRCLEL	Tells the turtle to travel to its left to draw a circle. A number is needed to tell the size of the radius of the circle to be drawn.
CIRCLER	Tells the turtle to travel to its right to draw a circle. A number is needed to tell the size of the radius of the circle to be drawn.
CLEARSCREEN (CS)	Clears the drawing from the screen and places the turtle at home.
FORWARD (FD)	Tells the turtle to move forward. A number is needed to tell how many steps.
HIDETURTLE (HT)	Makes the turtle invisible.
HOME	Tells the turtle to return to its home position.
LEFT (LT)	Tells the turtle to turn to its left. A number is needed to tell how many degrees to turn.
PENDOWN (PD)	Tells the turtle to put down the pen so it will draw a trail as the turtle moves. It is not used unless PENUP is used.

PENUP (PU)	Tells the turtle to lift up the pen so it will not draw a trail as the turtle moves.
REPEAT	Tells the turtle to repeat the commands in square brackets. A number is needed to tell how many times to repeat the commands.
RIGHT (RT)	Tells the turtle to turn to its right. A number is needed to tell how many degrees to turn.
SETX	Moves the turtle to the left or right.
SETY	Moves the turtle up or down.
SHOWTURTLE (ST)	Causes the turtle to appear on the screen.

Appendix



Suggested Answers to Exercise C

1. Turns will vary.
2. a. **RIGHT 180**
b. **LEFT 90**
c. **LEFT 120**
d. **RIGHT 60**
e. **LEFT 30**

Suggested Answers to Exercise F

1. **RT 90**
FD 50
RT 90
FD 30
HOME
2. **RT 90**
FD 40
LT 90
FD 50
HOME
3. **BK 40**
RT 90
FD 30
HOME

Suggested Answers to Exercise I

1. a. REPEAT 120[FD 1 RT 3]
b. REPEAT 90[BK 1 LT 4]
c. REPEAT 72[FD 1 RT 5]
d. REPEAT 36[BK 1 LT 10]
2. The circles become smaller as you decrease the number of turns.
3. The size of the circles increase.

Suggested Answers to Exercise K

1. TO SQ
REPEAT 4[FD 30 RT 90]
END
2. TO RECT
REPEAT 2[FD 10 RT 90 FD 50 RT 90]
END

Suggested Answers to Exercise L

1. TO SQUAREL :S
REPEAT 4[FD :S RT 90]
END
2. TO EQTRIR :S
REPEAT 3[FD :S RT 120]
END

TO EQTRIL :S
REPEAT 3[FD :S LT 120]
END

Suggested Answers to Exercise M

1. a. **SQUARER 10**
RT 90 FD 10 LT 90
SQUARER 20
RT 90 FD 20 LT 90
SQUARER 30

OR

REPEAT 4[FD 10 RT 90]
RT 90 FD 10 LT 90
REPEAT 4[FD 20 RT 90]
RT 90 FD 20 LT 90
REPEAT 4[FD 30 RT 90]

b. **SQUARER 20**
FD 20 RT 90 FD 20 LT 90
SQUARER 20
FD 20 RT 90 FD 20 LT 90
SQUARER 20

OR

REPEAT 4[FD 20 RT 90]
FD 20 RT 90 FD 20 LT 90
REPEAT 4[FD 20 RT 90]
FD 20 RT 90 FD 20 LT 90
REPEAT 4[FD 20 RT 90]

c. SQUARER 30
FD 30 LT 90
SQUAREL 10
BK 30 RT 90
SQUAREL 10
BK 30 RT 90
SQUAREL 10
BK 30 RT 90
SQUAREL 10

OR

REPEAT 4[FD 30 RT 90]
FD 30 LT 90
REPEAT 4[FD 10 LT 90]
BK 30 RT 90
REPEAT 4[FD 10 LT 90]
BK 30 RT 90
REPEAT 4[FD 10 LT 90]
BK 30 RT 90
REPEAT 4[FD 10 LT 90]

2. RT 90
EQTRIL 50
FD 10
EQTRIL 30
FD 10
EQTRIL 10

OR

RT 90
REPEAT 3[FD 50 LT 120]
FD 10
REPEAT 3[FD 30 LT 120]
FD 10
REPEAT 3[FD 10 LT 120]

3. EQTRIR 30

LT 90

SQUARER 30

RT 90 FD 30 RT 30

SQUARER 30

RT 90 FD 30

SQUARER 30

OR

REPEAT 3[FD 30 RT 120]

LT 90

REPEAT 4[FD 30 RT 90]

RT 90 FD 30 RT 30

REPEAT 4[FD 30 RT 90]

RT 90 FD 30

REPEAT 4[FD 30 RT 90]

Suggested Answers to Exercise N

1. CIRCLER 10

PU LT 90 FD 10 RT 90 PD

CIRCLER 20

PU LT 90 FD 10 RT 90 PD

CIRCLER 30

2. SQUARER 70

PU FD 40 RT 90 FD 10 LT 90 PD

SQUARER 20

PU BK 20 LT 90 FD 10 RT 90 PD

SQUARER 10

OR

REPEAT 4[FD 70 RT 90]

PU FD 40 RT 90 FD 10 LT 90 PD

REPEAT 4[FD 20 RT 90]

PU BK 20 LT 90 FD 10 RT 90 PD

REPEAT 4[FD 10 RT 90]

Suggested Answers to Exercise O

1. CIRCLES 24
PU FD 38 RT 90 FD 10 LT 90 PD
CIRCLES 14
PU FD 22 RT 90 FD 6 LT 90 PD
CIRCLES 8
2. CIRCLES 8
PU RT 90 FD 16 LT 90 PD
CIRCLES 14
PU RT 90 FD 28 LT 90 PD
CIRCLES 28

Suggested Answers to Exercise P

1. PU SETX -100 SETY 80 PD
SQUARER 20

OR

PU SETX -100 SETY 80 PD
REPEAT 4[FD 20 RT 90]
2. PU SETX 90 SETY -30 PD
RECTANGLER 30 10

OR

PU SETX 90 SETY -30 PD
REPEAT 2[FD 30 RT 90 FD 10 RT 90]

3. **PU SETX -30 SETY -30 PD**
EQTRIR 50

OR

PU SETX -30 SETY -30 PD
REPEAT 3[FD 50 RT 120]

4. **PU SETX -100 SETY 80 PD**
REPEAT 10[SQUARER 20 RT 90 FD 20 LT 90]

5. **PU SETX 0 SETY -50 PD**
REPEAT 3[SQUARER 50 FD 50]

Suggested Answers to Exercise Q

1. **REPEAT 18[EQTRIR 50 RT 20]**

2. **REPEAT 10[EQTRIR 50 PU FD 30 RT 36]**



This booklet cannot be purchased separately; it is available only with Module 6 of Mathematics 7.



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